SPECIFICATION

Terminal Connection Apparatus of Electric Device

Technical Field

The present invention relates to a terminal connection apparatus for bridging between terminals of neighboring electric devices (e.g., contactor, open/close device).

Prior Art

When a motor is positive/negative-operated, when one power source is connected to two loads in a switching manner, or when two power sources are connected to one load in a switching manner, two contactors or two open/close devices are provided so as to be adjacent to each other and a terminal connection apparatus is used for bridging between these terminals by a terminal connection conductor.

Fig. 5 is a wiring diagram of a tripolar electromagnetic contactor using such a terminal connection apparatus. First, Fig. 5 (A) shows the connection where two electromagnetic contactors 1 are used to perform the positive/negative operation of a motor. Here, with regards to the power source side, the space between terminals 1-1, the space between terminals 3-3, and the space between terminals 5-5 are bridged by the terminal connection conductors 2, 3, and 4 to be bridged in the order of phases (i.e., the same phases are bridged) and, with regards to the load side, the space between terminals 2-6, the space between terminals 4-4, and the space between terminals 6-2 are bridged by the terminal connection conductors 5, 6, and 7 to be bridged in the order in which phases are switched (i.e., to be bridged so that two phases of three phases are switched). As well known, a tripolar AC motor can provide normal rotation/reverse

rotation by switching two phases among three phases of R, S, and T. Thus, when the condition in which the electromagnetic contactor 1 in the left of Fig. 5 (A) being in the "ON" condition is assumed as normal rotation, reverse rotation is provided when the right side is in the "ON" condition. Similar switching also can be provided when the power source side and the load side are directly switched.

Next, Fig. 5 (B) shows that two electromagnetic contactors 1 are used to switch two loads A and B and in which the power source side is bridged in the order of phases. When the left side of Fig. 5 (B) is turned ON, then the load A is supplied with the power source and, when the right side is turned ON, then the load B is supplied with the power source. Fig. 5 (C) shows that two electromagnetic contactors 1 are used to switch two power sources A and B and in which the load side is bridged in the order of phases. When the left side of Fig. 5 (C) is turned ON, the power source A is supplied to the load and, when the right side is turned ON, the power source B is supplied to the load.

Fig. 6 shows an example in which a conventional terminal connection apparatus is used to provide a reversible type electromagnetic contactor used for the positive/negative operation of a motor. Fig. 6 (A) shows the side view and Fig. 6 (B) shows the front view. In Fig. 6, two electromagnetic contactors 1, 1 are provided on an attachment base 8 so as to be adjacent to each other and are interlocked by a mechanical interlock apparatus 9 so that the two contactors are not turned ON at the same time. As shown, the space between the terminals at the power source side (upper side) is bridged by the terminal connection conductors 5 to 7 in the order of the switching of phases while the space between the terminals at the load side (lower side) is bridged by the terminal connection conductors 2 to 4 in the order of phases.

Fig. 7 and Fig. 8 respectively show different conventional examples illustrating the terminal connection conductor 2 in Fig. 6, for example. In the drawings, "(A)" is the side view, "(B)" is the front view, and "(C)" is the lower face view. First, in Fig. 7, the terminal connection conductor 2 consists of a U-shaped conductor punched out of a plate material, both ends of which are bent to have a right angle to provide a terminal section 2a. The space between the terminal sections 2a, 2a is covered by an insulation material 10. In Fig. 7, the insulation material 10 is applied, for example, with a polyethylene resin immersion coating or a powder insulation coating. The terminal connection conductor 2 of Fig. 8 has the same structure as that of Fig. 7 but the former is different from the latter in that the insulation material 10 is formed by a tube that contracts when being subjected to heat. In Fig. 6, for the purpose of saving space, the terminal connection conductor 3 is provided to have a Ω-like shape and the terminal connection conductor 6 is provided to have a strip-like shape and they are connected to the terminal connection conductors 2 and 4 and the terminal connection conductors 5 and 7 so as to be perpendicular thereto, as shown in Fig. 6.

Spanish Patent Publication No. ES2081243 discloses a different conventional technique regarding a terminal connection apparatus for bridging between the terminals of two electric devices provided to be adjacent to each other. This apparatus is designed such that an electric insulation element having a groove for guiding an electric wire is provided, and the groove is inserted with an electric wire for bridging between the terminals.

The terminal connection conductor of Fig. 7 insulation-coated by an

immersion coating or a powder insulation coating can be applied, as shown in the drawing, with an insulation coating up to the root of the terminal section but has a problem in that the insulation coating material needs to be dried for a long time, causing a poor workability. In contrast, the terminal connection conductor of Fig. 8 using a thermal contraction tube has, when compared to the conventional example of Fig. 7, a superior workability for the insulation coating but such a thermal contraction tube tends to have wrinkles during the contraction (the corner section where the conductor is bent in particular tends to have a complicated shape due to the wrinkles). In view of this, when a thermal contraction tube is used, conventional techniques have prevented such a conductor bend section from being insulation-coated as much as possible so that the insulation coating can be provided to the middle part of the U-shaped section (see Fig. 8). However, this causes the conductor to be exposed in a wider area, thus causing a risk of a short-circuiting accident caused when this exposed part is adhered with a conductive foreign material (e.g., scraps of electric wire) or an electric shock accident due to the contact with a finger, for example. The terminal connection apparatus for reversible operation of Fig. 6 also had a problem in that the wiring tends to be carried out incorrectly because six terminal connection conductors are connected separately.

On the other hand, regarding the apparatus according to Spanish Patent Publication No. ES2081243 in which an electric wire is inserted to the groove of an electric insulation element, exposed electric wiring is contained in a narrower space which thus reduces the risk of electric shock accidents. This apparatus also has an advantage in that the wiring can be arranged with more precision because terminals can be connected after all electric wires are retained by electric insulation elements. However, grooves inserted with electric wires require different route patterns in

accordance with the wiring type (e.g., order of phase, phase switching), thus causing a problem in that an increased number of types of electric insulation elements renders the layout more complex. A deeper groove for providing an enhanced insulation also tends to cause the deformation of a resin-formed electric insulation element, thus causing a problem where an electric wire sometimes cannot be inserted into the groove. Such a groove also causes a risk in which the insulation of an electric insulation element may be deteriorated due to dust or the like because the groove in the electric insulation element is in an "open" condition before being inserted with an electric wire.

The present invention intends to solve these problems. It is an objective of the present invention to improve the insulation of the terminal connection conductor, to prevent an incorrect wiring operation, and to simplify the wiring work and the management of components.

Disclosure of the Invention

In order to solve the above problems, according to the invention of Claim 1, a terminal connection apparatus of an electric device is provided in which the terminal connection apparatus has terminal connection conductors for a plurality of phases for bridging between the terminals of two electric devices provided to be adjacent to each other and, this terminal connection conductor has, at both ends thereof, terminal sections connected to the terminals of the electric devices and consists of a U-shaped conductor in which the space between these terminal sections is covered by an insulation material, wherein an insulation case for collectively surrounding the terminal connection conductors for a plurality of phases except for the terminal sections is provided and this insulation case houses therein the terminal connection

conductors for unitization.

According to the invention of Claim 1, the terminal connection conductors for a plurality of phases are collectively housed in the insulation case for unitization. This enables the insulation of the terminal connection conductors to be completely protected from the exterior. This also can adopt, since each of the terminal connection conductors can be insulation-covered in the minimum range required for interphase insulation, the minimum amount of insulation covering utilizing a thermal contraction tube, thus simplifying the insulation covering operation.

The terminal connection conductors for a plurality of phases are connected while being unitized by the insulation case, thus suppressing an incorrect wiring operation. On the other hand, the insulation case is provided to have a box-like shape to collectively house therein the terminal connection conductors for a plurality of phases and thus can be widely used regardless of the wiring type (e.g., phase order wiring, phase switching order wiring). Furthermore, the insulation case is sealed by a cover body, thus preventing the insulation from being deteriorated due to the ingression of dust or the like.

According to the invention of Claim 2, in the invention of Claim 1, the terminal connection conductors consisting of a plate material are provided to be parallel to one another in the plate thickness direction. This allows the entire configuration to be retained more securely when compared to a terminal connection conductor using an electric wire, and also enables the apparatus to have a thinner shape.

According to the invention of Claim 3, in the invention of Claim 2, the insulation case consists of a box-shaped body having at the upper face an opening, and having at the upper edge a notch engaged with the terminal section of the terminal connection conductor and a plate-shaped cover body attached to this body by being engaged therewith and covering the opening and, the terminal connection conductor that is inserted to the body and in which the terminal section is projected via the notch is pressed by the cover body to be fixed. This allows an insulation case having a simple structure to enable the terminal connection conductors to be positioned according to need, and the complete protection of the insulation by surrounding the terminal connection conductors.

According to the invention of Claim 4, in the invention of Claim 2, the terminal connection conductor is covered by a thermal contraction tube. This covering may be provided in the range required for interphase insulation, and for the exposed terminal connection conductor parts, an insulation case is provided.

Brief Description of the Drawings

Fig. 1 is an exploded perspective view of a phase switching terminal connection apparatus illustrating an embodiment of the present invention.

Fig. 2 is an exploded perspective view of a phase order terminal connection apparatus illustrating an embodiment of the present invention.

Fig. 3 is a perspective view illustrating the appearance of the terminal connection apparatus of Fig. 1 or Fig. 2.

Fig. 4 shows an electromagnetic contactor using the terminal connection apparatus of Fig. 1 and Fig. 2. Fig. 4 (A) shows the side view while Fig. 4 (B) shows the front view.

Fig. 5 shows a wiring diagram of a tripolar electromagnetic contactor using the terminal connection apparatus. Fig. 5 (A) shows a motor reversible operation, Fig 5 (B) shows load switching, and Fig. 5 (C) shows power source switching.

Fig. 6 shows an electromagnetic contactor using a conventional terminal connection apparatus. Fig. 6 (A) is the side view and Fig. 6 (B) is the front view.

Fig. 7 shows a terminal connection conductor in a conventional terminal connection apparatus. Fig. 7 (A) is the side view, Fig. 7 (B) is the front view, and Fig. 7 (C) is the lower face view.

Fig. 8 shows a different terminal connection conductor in a conventional terminal connection apparatus. Fig. 8 (A) is the side view, Fig. 8 (B) is the front view, and Fig. 8 (C) is the lower face view.

(Description of Reference Numerals)

1	Electromagnetic contactor
2 to 7	Terminal connection conductor
9	Interlock apparatus
10	Insulation material
11	Insulation case
12	Insulation case body

13 Insulation case cover body

Best Mode for Carrying out the Invention

Hereinafter, with reference to Fig. 1 to Fig. 4, an embodiment of this invention will be described. Fig. 1 is an exploded perspective view of a terminal connection apparatus of a phase switching connection. Fig. 2 is also an exploded perspective view of a terminal connection apparatus of phase order connection. Fig. 3 is a perspective view illustrating the appearance of the apparatus of Fig. 1 or Fig. 2. Fig. 4 (A) is a side view of an electromagnetic contactor for reversible operation using the apparatus of Fig. 1 or Fig. 2. Fig. 4 (B) is the front view. In the drawings, the same components as those of the conventional example are denoted with the same reference numerals. In Fig. 1 and Fig. 2, the terminal connection conductors 2 to 7 consist of a U-shaped conductor pressed out of a plate material and both ends thereof are bent to have a right angle to provide terminal sections 2a to 7a. The conductor part except for the terminal sections 2a to 7a is covered by the insulation material 10 consisting of a thermal contraction tube. This insulation covering 10 covers, as shown in the drawing, only up to the middle of the U-bend part of the conductor for the minimum covering required to provide the interphase insulation of the terminal connection conductors 2 to 7, thus suppressing wrinkles caused at the thermal contraction.

The terminal connection conductors 2 to 7 for a plurality of phases (tripolar in the drawing) are collectively surrounded, except for the terminal sections 2a to 7a, by the insulation case 11 consisting of a mold resin. The insulation case 11 consists of a box-shaped body 12 having at the upper face an opening, and a plate-shaped cover body 13 for covering the opening. The upper edge of the front face of the body 12 has six notches 12a engaged with the terminal sections 2a to 7a of the terminal connection

conductors 2 to 7 and the center of the front face and both ends thereof have an engagement section 12b engaged with the cover body 13. On the other hand, the cover body 13 has, at the front edge thereof, six convex sections 13a engaged with the notches 12a of the body 12 and an engagement nail 13b is provided to correspond to the engagement section 12b of the body 12.

As shown in Fig. 1 and Fig. 2, the above-described terminal connection conductors 2 to 7 are attached by superimposing them so as to be parallel to one another in the plate thickness direction to insert them to the body 12 while engaging the terminal sections 2a to 7a with the notches 12a, after which the convex section 13a is engaged with the notch 12a to engage the cover body 13 to the opening of the body 12, thereby engaging the engagement nail 13b to the engagement section 12b in a snap fit manner. As a result, the terminal connection conductors 2 to 7 housed in the body 12 are positioned by the notches 12a via the terminal sections 2a to 7a and are pressed and fixed by the cover body 13. This allows the terminal connection conductors 2 to 7 for the respective phases to be integrally unitized via the insulation case. Fig. 3 shows the terminal connection apparatus unitized in this manner.

The terminal connection apparatus of Fig. 3 in this condition is placed on the two electromagnetic contactors 1, 1 shown in Fig. 4 to be connected as shown in the manner to bridge the spaces of the terminals for the respective phases. In Fig. 4, the upper side is the power source side to which the terminal connection apparatus of a phase order connection type shown in Fig. 1 is connected while the lower side is the load side to which the terminal connection apparatus of phase switching connection type shown in Fig. 2 is connected. As a result, left and right electromagnetic contactors 1, 1 are alternately turned ON as described above, thereby switching the

positive/negative operation of a motor (not shown). In Fig. 4, the terminal connection apparatus is tightened to the main terminal of the electromagnetic contactors 1, 1 via the block terminal 14. This structure will be not described because the block terminal 14 is irrelevant to the present invention.

When compared to the conventional techniques, the terminal connection conductor of the shown embodiment has the advantages as shown below.

(1) The terminal connection conductors 2 to 7 are collectively surrounded by the insulation case 11. This prevents, even when the terminal connection conductors 2 to 7 have an exposed conductor, an accident (e.g., short-circuiting caused when the exposed part is adhered with foreign material or an electric shock due to contact with a finger).

(2) Due to the reason shown in the above (1), the terminal connection conductors 2 to 7 can have an exposed conductor to the maximum allowable limit in terms of preventing interphase short-circuiting, thus suppressing, even when a thermal contraction tube that can be covered easily is used, wrinkles caused by the thermal contraction by minimizing the insulation covering of the U-bend part of the conductor.

(3) The terminal connection conductors 2 to 7 can be connected to the electromagnetic contactor 1 while being unitized in an integral manner, thus preventing an incorrect wiring operation and simplifying the wiring operation.

(4) The insulation case 11 is entirely sealed and thus the insulation at the inner side is prevented from being deteriorated.

(5) The box-shaped insulation case 11 only surrounds the terminal connection conductors 2 to 7 from the exterior and does not have complicated rib or grooved structures, thus can be easily resin-formed and be resistant to deformation.

(6) The box-shaped insulation case 11 can be commonly used for both of the phase

Fig. 1

7	Terminal connection conductor
10	Insulation material
11	Insulation case
12	Body
13	Cover body

Fig. 5

Motor positive/negative operation

Power source

Load motor

Load switching

Load A

Load B

Power source switching

Power source A

Power source B

Load